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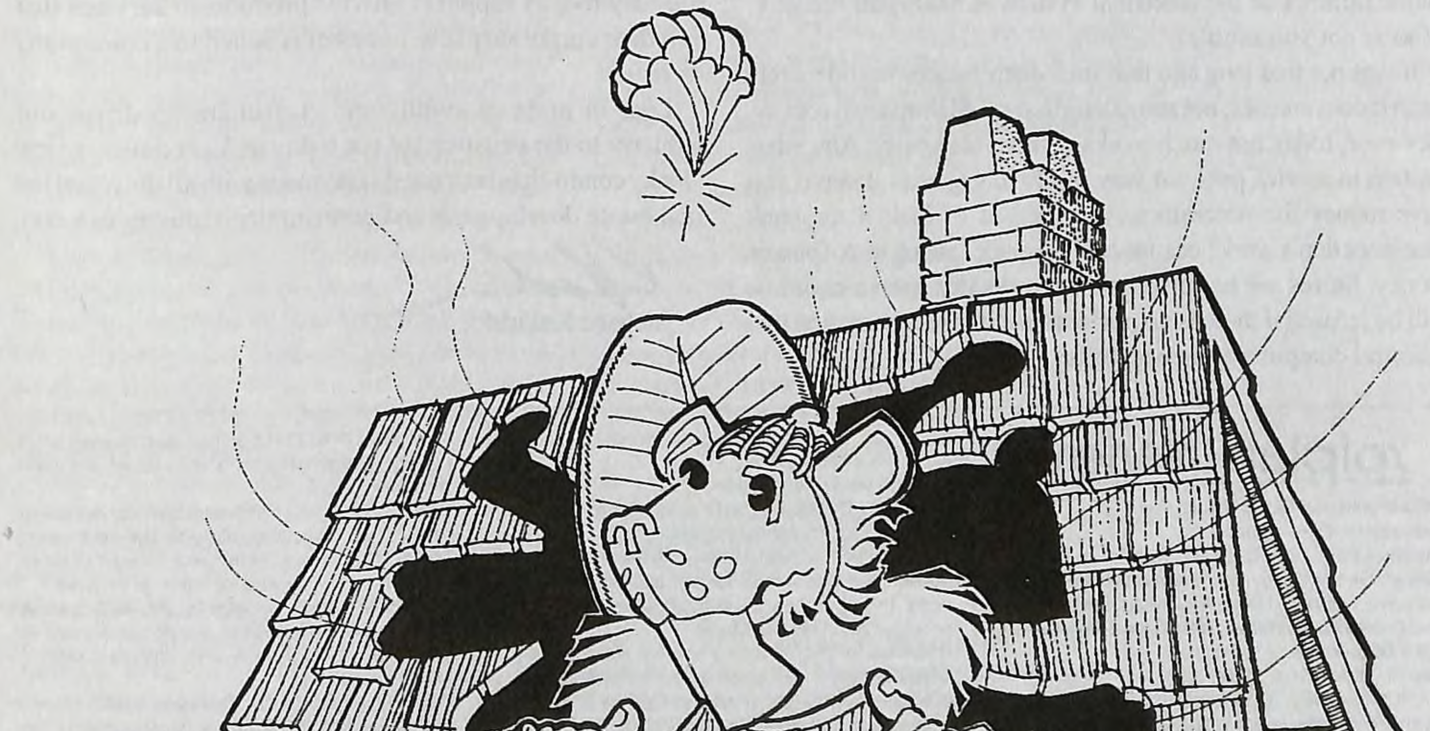

From the Editor . . .

Recent events have made me wonder if our love affair with high technology hasn't gone too far.

Now, I am no Luddite wanting to go back to the days of horse and buggies, hammers and hand saws. I too have been involved in my share of technology promotion. I am just as fascinated by the wonders being developed, even if I don't understand how they may work or even if we really need them. Much positive can be said for continued technological progress. However, most of the technology we see today has been developed just within one or two lifetimes. Think of all we have that simply did not exist when our grandparents were young. But can we cope with and manage rapid, technology driven change?

The ice storm in Eastern Canada this past winter showed us just how vulnerable we are to the forces of nature, in spite of our technology. Now that spring is here, last winter's trauma will soon be forgotten. But we cannot always blame the weather. I have recently been following stories buried in the back pages of our newspapers and on the Internet (!), about power outages in Auckland, New Zealand - this in the middle of their summer (the centre of the city is expected to be without power for no less than 6 to 8 weeks). There were also unrelated major failures of the electrical system in Malaysia recently. Who is not vulnerable?

It was not that long ago that such disturbances would merely be an inconvenience, not something that could shut down society. However, today not much works without electricity. Any interruption in service puts our way of life in jeopardy. Even if you have money for necessities, you are out of luck if the bank machines don't work because of the ever increasing use of plastic money. Stores are so wired into networks that even a cash sale will be refused if there is no power to record the transaction into a central computer somewhere else.

How much of the damage due to the electrical disruptions, here or in other parts of the world, can be attributed to natural causes, legitimate technical failures, or to a lack of attention to maintenance, sustainability and security of supply because it might affect this year's bottom line? How much of this would be possible without today's high-tech systems?

There are still many parts of the world where modern conveniences have not penetrated to dominate life to the extent we know it. Although it may seem primitive, self reliance is still a feature of life. That is why in parts of Eastern Europe, for example, where despite the collapse of the economy, where nothing seems to work, people can manage to smile, make ends meet, and life goes on!

The reliance on high-tech is often dehumanizing and can contribute to community breakdown and loss of social values. Where is the place for individual pride in quality and craftsmanship? Changes in the retailing industry, where the "big box" stores simply rely on volume, with little care for their impact on the community, provide little possibility for personalized customer service. The same forces have driven the banks to be arrogant toward their customers. The mass market, cookie cutter approach affects the construction industry too, as suppliers provide products or services that suit their corporate plans, not what is suited to a community or region.

Loss in pride of quality and craftsmanship drives our industry to the situation we see today in Vancouver, where "leaky condo" has become synonymous with all the worst the real estate development and construction industry can do.

Richard Kadulski,
Editor

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Editor-Publisher: Richard Kadulski
Illustrations: Terry Lyster
Contributors: John Broniek, Rob Dumont, Jim Stewart, Geoff Murphy, Matts Myhrman, Bob Platts, Catherine Lalonde, David Rousseau, Paula Baker, Dvid Brook, Paul Stratton, Joh Gulland, John Bower
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Box 86627, North Vancouver, B.C. V7L 4L2
Tel: 604-689-1841 Fax: 604-689-1841
e-mail: solplan@direct.ca
Street address:
208-1280 Seymour St.
Vancouver, B.C. V6B 3N9

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Attic Ventilation

Building codes require attics to be ventilated. The intent is to remove moisture that escapes from the building's interior into the attic. Does ventilation really work? How much is really needed? Does the ventilation need differ for different climatic conditions or house styles? Code requirements do not give recognition for differing climates, housing styles, construction practices or the presence of alternate moisture control strategies.

Computer simulations show that in extreme climactic zones in Canada, (such as the Prairies), attic ventilation may be prudent and the code specification of a vent area of 1:300 is generally satisfactory. However, in more moderate climates such as coastal climates, the same simulations suggest that the same code requirement tends to over ventilate attics - actually contributing to higher moisture levels!

Reducing roof ventilation goes against common wisdom. However, attic ventilation requirements are one of those issues that has had little scientific study. Code requirements at the moment are based on field experience gained by trial and error rather than study. A recent monitoring study for CMHC by Sheltair Scientific measured the effect on attic moisture levels resulting from the elimination of all intentional attic roof ventilation in new houses. It provides actual measured performance data.

The moisture levels in the attics of new houses (in Edmonton and Vancouver) built with no intentional attic ventilation were measured (between fall and spring) and compared with the moisture levels in the attics of four similar houses with conventional ventilated attics. All were built over the summer of 1996.

Each of the houses with no attic ventilation was paired with a "control" house built by the same builder with as similar a location and design as possible but meeting code ventilation requirements. An air leakage test was done on each house to measure the leakage between the attic and outdoors, between the attic and the house, and between the house and outdoors.

The north facing roof sheathing was always found to have the highest wood moisture level.

In both Vancouver and Edmonton, one house built with no attic ventilation was found to be drier and the other was found to be wetter than its corresponding control house. Only the attics of one pair of Vancouver houses had high wood moisture levels. The north roof sheathing of one control house (i.e., a vented attic) reached a moisture level of 30% in midwinter. The attic of its partner house, with no attic ventilation, also had high moisture levels but it remained drier. The attics of all other Vancouver and Edmonton houses remained relatively dry throughout the study period with moisture contents of north facing roof sheathing remaining below 19% moisture content in every case.

The moisture level of roof truss members in all houses had small fluctuations, but the moisture level always was less than 15%. The moisture content of truss members in all houses remained lower than that of the north facing roof sheathing. Differences in attic wood moisture content had no relationship to how much air leakage there was at the ceiling between the house and attic.

For each pair of houses, the house that had higher moisture levels in the north side sheathing also had a more airtight ceiling.

Higher indoor relative humidity levels inside the house generally meant higher moisture levels in the attic no matter how much attic ventilation there was or the air tightness of the ceiling. This also meant wetter attic sheathing.

No condensation or frost was observed in any of the Vancouver houses. In Edmonton, three of the four houses had some frost on the inside of attic sheathing in midwinter even though sheathing moisture levels were not very high. In both cities the wood moisture content in attics generally peaked in January/February, and was lower than the moisture content in the roof sheathing.

The conclusions of the study suggest that eliminating attic ventilation will not change the wood moisture content in the structure.

From the perspective of moisture control, attic ventilation in mild climate areas is not as important as has been considered. This does mean that moisture control and air sealing are not important. Rather, it suggests that attic ventilation is not critical when a reasonable job has been done to reduce air leakage from the house at the ceiling level. ☼

From the perspective of moisture control, attic ventilation in mild climate areas is not as important as has been thought.

Attic Ventilation and Moisture Control Strategies
For Research Division CMHC
by: Sheltair Scientific Ltd Vancouver, B.C.

Ice Damming

Ice Dam Research Data Analysis
Prepared for: Canada Mortgage and Housing Corporation
by: Scanada Consultants Limited

Ice damming has been a problem in some areas for a long time. It happens where melting roof snow freezes on the cold overhang, building up an ice dam so that melting water can penetrate under the roof shingles a significant distance above the eaves, over the finished living space.

For ice dams to occur there has to be a heat source to melt the snow on the roof when exterior temperatures remain below freezing. Attic heat sources can include interior heat loss through unevenly distributed attic insulation and point sources of heat such as chimneys, skylights, and exhaust vents through soffits.

The winter of 1995-96 had conditions favourable for roof ice damming, and as could be expected, it created many problems. Thirty-three Ottawa houses with and without ice damming were monitored from late February to mid-March, 1996 to find out if ice dams were caused by warmer attics. Heat loss through the ceiling and insulation was measured.

All houses had blown-in insulation, but insulation levels were less than the building code's minimum required in most of the houses with ice dams and about one third of the houses without ice dams. In all cases there was a reduction in insulation thickness at the outside wall.

Most houses tested had prefabricated metal chimneys. Air leakage around the chimney penetration through the top floor ceiling is a suspected heat and moisture source into the attics. The chimney in all the houses with ice dams passed through the top floor ceiling, while in most of the houses without ice dams the chimneys are located outside the insulated walls (i.e., these chimneys do not penetrate the ceiling air/vapour barrier).

A significant difference was noted between the houses with ice dams and those without. The average attic temperature of the houses with ice dams was 3.9°C warmer than the attics without ice dams.

Heat can escape from the attic by conduction through the roof deck and through roof vents. It is thought that inadequate soffit venting may be part of the ice damming problem in warmer attics. That is why cold roof details are beneficial.

Attic venting may not be critical for moisture removal in all climates but it helps keep the roof deck cold to avoid snow melt and ice damming in areas subject to conditions where it could be a problem. ☼

Ozone Generators

FTC Charges Alpine Industries for Violation of Order

The US Federal Trade Commission (FTC) has alleged that Alpine Industries Inc. has violated a 1995 order by continuing to make claims that its ozone-generating "air cleaner" devices remove many pollutants better than other methods and prevent or relieve medical or health-related conditions.

In 1995 the FTC challenged Alpine's claims. A trial was avoided when the company agreed to be bound by an FTC order. However, the FTC claims Alpine's advertising material still makes unsubstantiated claims that their products effectively eliminate or clean pollutants from indoor air, that ozone is more effective in cleaning or purifying indoor air than other methods, and that their air cleaning products prevent or provide relief from medical or health-related conditions.

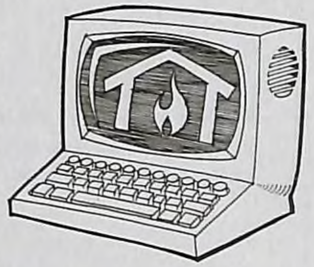
The current order calls for Alpine Industries to *"forthwith cease and desist from representing, in any manner, a) that such product's ability to eliminate, remove, clear, or clean any indoor air pollutant from a user's environment; or b) such product's ability to eliminate, remove, clear, or clean any quantity of indoor air pollutant from a user's environment; unless, at the time of making such representation, respondents possess and rely upon competent and reliable scientific evidence that substantiates the representation."*

The Workers Compensation Board in BC tested some units, and found that ozone levels were at unsafe levels.

Alpine Industries's products are still being marketed in Canada, using many of the same brochures. ☼

HOT2™XP

Software Review



The evolution of computer hardware and software has moved at a fast pace. The capacity of computers, and basic operating systems have come a long way from the early 1980's when MS-DOS was the standard, and a 286 AT was the state-of-the-art computer. User friendly software in most cases was only a dream.

HOT-2000 was developed for the R-2000 program as a compliance and design tool. HOT-2000 has gained international respect for its thoroughness and accuracy when analyzing homes. The core of the program has been thoroughly validated, and has gone through several refinements, but it has always been a DOS-based program. Preparation of data for analysis and use of the software is not the easiest task. Less well known is that several variations have been prepared for special applications, for home energy retrofit analysis, and proposed energy code compliance.

HOT2™XP (just released) has been developed as a simplified, quick-entry version of HOT-2000 meant to provide quick, "what-if" analysis of basic construction options. HOT2™XP is the first of the group of programs designed for use in the Windows 95 environment. Its graphic interface is relatively simple to use with few detailed calculations needed before data input can continue. Several different reports can be generated, including a very client friendly report that presents information in graphic form. Because it is a simplified form of HOT-2000, it cannot be used for compliance review of R-2000 houses at this time.

While there are many good features in the program, seasoned HOT-2000 users will want much more than is offered by HOT2™XP. As often happens in the computer industry, the software seems to have been released prematurely. There are limitations in this version of the program. Although it is a version of HOT-2000, it cannot view files from earlier versions, nor can it export files to the other versions.

If the house you are reviewing is simple in shape, able to use the built-in defaults, then you can take advantage of HOT2™XP. You can enter a house shape that most closely meets the picture in the program's library. If the house you want to model has many dormers, bays, and wings, using HOT2™XP will be difficult if not impossible.

Unfortunately, if you want to make a change, say, add a wing or add a floor to the basic house you have modelled, then all building envelope entries you have customized for the house are reset to the default entries - so you have to re-enter all the information. It could be labourious (especially if you have just entered customized data for 15 different windows!) and works against the intent of having a simple design and analysis tool that can be used to calculate "what if" options.

The library of building components cannot be edited but you can create a customized library, although this can be cumbersome. Documentation and help files are rudimentary. The printed manual is only 12 pages long, mostly providing information on setup procedures. Most help information is on disk, so as with other Windows software, it can be found anytime by clicking the help icon.

Unfortunately, the software cannot easily model all current code conditions from default inputs - especially slab-on-grade construction. In BC, heated slabs (i.e., radiant heated floors) have to be insulated, but the only way to be able to model insulated concrete slabs is to create a new library entry, as the default conditions are not insulated. This can be a cumbersome procedure.

If the house designs you deal with are simple, then this may be a tool you might want to check out. Unfortunately, I'm not completely impressed with this version yet. Given the house designs that are being used today in many parts of the country, many simply cannot be simulated with this software. I am told that some shortcomings I have noticed are known, and are being worked on. An update with corrections and modifications is expected in a few weeks, so that purchasers will receive the update.

A Windows 95 version of the more sophisticated HOT2000 (to be known as version 8) is in the final stages of completion, and is expected to be ready later this spring. ☼

HOT2™XP system requirements:
Windows 95 or Windows NT
IBM 486 compatible or Pentium with 6 MB free RAM, 1.44 MB floppy drive
SVGA monitor (Min. 640 x 480)

Copies can be purchased for $150.00 plus taxes directly from Natural Resources Canada contact: Geoff Murphy, fax 613-996-9909
or e-mail: *hot2@nrcan.gc.ca*

a demo copy can be downloaded from:
http://greenbuilding.ca/abc-dtbs.html#SOFTDEMO

Straw Bale Construction

Build It with Bales, by Matts Myhrman and Steve MacDonald.
US$ 29.95
published by:
Out on Bale, (un) Ltd.
1037 E Linden St
Tucson, AZ 85719
e-mail: biwb@juno.com

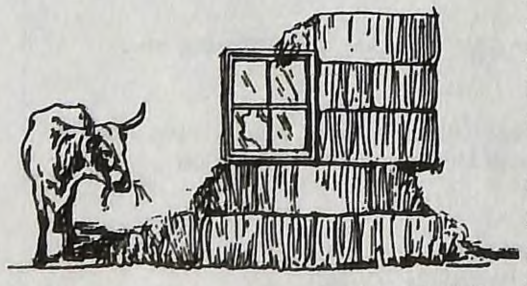
We are becoming aware of the need to use resources efficiently and to lower the impact on the environment overall. The building industry has not been doing very well in the wise use of resources. It is questionable whether wood frame construction, clearly the most successful building system based on renewable fibre, is consuming forest resources at a sustainable rate. Forest product innovators have been responding, striving for sustainability and "value added" by using wood more efficiently. Many innovations take the form of "engineered" composites that yield more from less.

There is also a renewed interest in alternative building materials. One of these that is gaining a niche is straw bale construction. At first thought, the children's fairy tale about the three little pigs comes to mind.

A more careful review suggests that there may be merit in considering straw as a serious building material. Straw pressed into rigid panels has been used in many parts of the world, and soon will be more widely available in North America. (These panels have excellent structural properties, high fire resistance, and good acoustic properties).

Use of straw bales as a construction material is not a recent development by back-to-the-land hippies. A technique (known as the Nebraska Straw Bale System) was developed more than 100 years ago. The remarkable Nebraska innovators years ago were simply using the resources they had: straw and the horse-drawn straw baler. The system's structural, thermal and fire resistance performance are exceptional.

Use of the technique in Nebraska, most widespread from about 1915 to 1930, appears to have ended by 1940. Of the seventy structures from this period documented in 1970, thirteen were known to still exist in 1993 and all but one of these were still being lived in or used. The end of the others can almost certainly be attributed to lack of maintenance resulting from abandonment. Once water begins to get through the roof and into the walls, the end is inevitable.



Drawing by Arlen Raikes

The most serious enemy of straw is prolonged exposure to water. High rainfall can be dealt with by proper design and detailing (e.g., adequate roof overhangs, flashing at window and door openings) and regular maintenance of the roof and wall surfaces.

The ideal climate for straw-bale construction may be semi-arid, with hot summers and cold winters. This type of climate has low moisture and good drying potential for the moisture that is present.

A common question that arises is what about vermin (i.e., rodents and insects)? As it is for a frame structure, the secret lies in denying unwanted critters a way to get in and out of the walls.

Fire resistance is a major concern, especially with a flammable material like straw. However, since the bales are covered with plaster, once finished, a bale building is extremely fire-resistant.

Is straw-bale construction inherently less costly? Proponents often call up the low cost of the material. However, a custom-designed straw-bale house built by a contractor using paid labour cannot cost less than a frame or masonry house providing the same interior space.

The cost (labour and materials) attributable to the exterior walls of modest homes generally accounts for only 15 to 20% of the total project cost. Using straw bales to replace insulation and wood, metal, or masonry, can only affect this already small piece of the pie. The cost actually increases due to the wider foundations and bigger roof area needed.

The insulating value of a straw bale is a bit less than for fibreglass batt. It is estimated that a dry bale has an R-value of 2.5 to 3.0 per inch thickness. However, a typical straw bale is 18" or 24" thick, so that the effective R-value will be over R40.

Straw bale walls can be built as load bearing walls, or merely as in fill walls to provide high insulation levels. The wall construction at first glance looks like masonry (with oversized blocks) having a density of about 8.5 pounds per cubic foot, but bales are unlike any building material. Masonry units are brittle, non-compressive and fail catastrophically when loaded past their limit. Wood frame construction has some flexibility, but it is essentially non-compressive under vertical loading until failure occurs.

On the other hand, straw bale walls are flexible, compressive and relatively elastic, responding to loading by gradual deformation rather than sudden, brittle failure. A load of bales may show considerable variability in dimensions, degree of compaction and moisture content. Even a single bale is not homogeneous. In a given area, bales are usually produced during a short period once a year.

Despite straw's quirks, there are a growing number of people using it as a construction material. So many that Arizona, California, Nevada, Texas and New Mexico have or are finalizing code requirements.

Build It With Bales is probably the definitive how-to guide to straw-bale construction. The second edition has just been published (the first edition in 1994 has sold more than 7,000 copies).

Part One of the guide lays out the things you may want to know, think about or do before you build. Part Two takes you through the building process in great detail, with many easy to follow sketches.

As the authors say, "It's not heavy enough to be a good doorstop and the movie version isn't out yet, so you might as well read it." If straw bale construction is something you want to know about, or consider, this is the book for you. ☼

*For more information on straw bale construction also check out **The Last Straw Journal**. This quarterly publication includes case studies, resources, code information and much more.*

The Last Straw Journal
P.O. Box 42000
Tucson, AZ 85733

email: thelaststraw@igc.apc.org

Straw Bale Construction

Performance testing of straw bale construction

Pilot Study of Moisture Control in Stuccoed Straw Bale Walls
for Canada Mortgage and Housing Corporation
Bob Platts, by Fibrehouse Limited

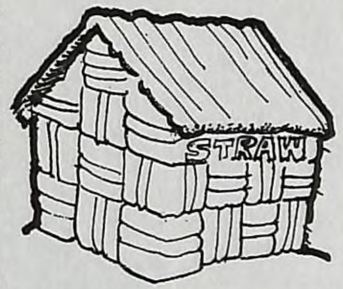
Use of the Nebraska wall system has spread into damper climates including areas with wind-driven rain such as Nova Scotia and the West Coast. This raises an old concern: how does this system deal with moisture? After all, moisture is the enemy of cellulose fibre and is a constant fight in wood frame housing. The problem of entrapped moisture has already shown up where detailing and/or skin materials are no match for the severe exposures. If the straw stays wet well into summer warmth, rot will follow.

Experience with wood frame and other cellulose fibre materials has proven that the accumulation and retention of excessive moisture will degrade their performance and make them unserviceable in just a few years.

The big question yet to be determined is what is the nature and severity of the moisture problem to the durability of the stuccoed straw bale walls? On the one hand, plastered straw bale house construction has a long and successful performance record of more than 100 years, but under the ideal conditions of the dry Nebraska plains.

Another potential problem is that today's stuccoes often have a high proportion of Portland cement, which is alkali. Some alkalies in Portland cement are known to attack some cellulose fibres.

A pilot study tested a couple of straw bale houses in the Ottawa area. Two "worst case" cases were searched out and compared with one that would have been expected to be sound and dry. The limited sample does not provide definitive conclusions, but useful observations can be made. The results of this small study suggest that the alkaline stuccoes, whether lime rich or cement rich, do not attack the straw but appear to preserve the fibre they encase. However, the cement rich stuccoes may be too impermeable to water vapour (not "breathable" enough) to be of value to be used as exterior skins in cold country. The lime rich stuccoes maybe too permeable to liquid water for use in climates with driving rain.



The problem areas spotted in the straw all could be explained. In all cases, these were moisture sources, paths for water and entrapment resulting in the net annual wetting that approached or exceeded the net drying potential. Straw that stays moist enough into the summer warmth will rot. Wood in the same moisture state and duration would rot similarly, but would avoid or delay that condition in most of these cases because wood frame walls drain better than stuccoed straw bales.

Severely damaged areas in the stuccoed bale walls were marked by faint surface telltale signs and perhaps generally can be found and fixed easily. The problem of excessive moisture can be avoided altogether at the design and construction stage. The report's author concludes with a cautionary point. We would not be confident building stuccoed straw bale in all regions.

Straw is not magic, what is not done lightly with wood should not be done with straw. Sound building science principles must be followed. ☼

R-2000 Homes in the Ice Storm

This winter's ice storm in Central Canada created much damage and anguish. It also pointed out the importance of good building standards. Against the backdrop of many people huddled in shelters, were those outside the ice storm area who enjoyed uninterrupted electricity and heat in their homes. Many have felt a certain amount of guilt, knowing that so many others were struggling to stay warm.

Then there were those inside the hard hit areas who went without electricity for days or weeks. They also felt guilty because life in their R-2000 Home was just too comfortable.

If the ice storm had hit in 1898 rather than 1998, the overall impact would have been much smaller. In those days forced air central heating (or any central heating) was a rare exception, and few homes had plumbing. If you don't have central heating, a massive storm will not make much of a difference.

In the past 100 years, our expectations have changed. Homes without heat or running water are just not acceptable. How we provide the comforts and meet these expectations is open to interpretation and debate. Until just a generation ago, we built homes and installed massive heating units to keep us warm. In the past 20 years we have learned how to build homes that can meet most if not all our heating needs by relying on natural energy sources (disconnected from the grid). The question for some may be how to do it?

One way is to build to R-2000 standards. R-2000 homes are not energy independent, but they go a long way toward it. R-2000 Homes are the most energy-efficient and environmentally responsible market homes today. The draft-free construction and high insulation levels found in R-2000 Homes make them well suited to Canada's demanding climate. Without undue effort, going much further is possible.

R-2000 Homes are known for having even temperatures throughout, eliminating drafts and cold spots. This was dramatically displayed in R-2000 Homes in the ice storm area that remained at a comfortable temperature throughout the house. Gloria Hovey of Manotick, Ontario said she "felt guilty being so comfortable while other families were cold and often forced to leave their homes." During five days without electricity her 2,900 square foot R-2000 Home remained at a comfortable 20 to 21 °C, warmed by a single wood burning fireplace. "We never had to think about leaving our home during the power outage," Hovey says. "Every corner of the house was comfortable with just a short-sleeved T-shirt on."

Claude Réel in Saint Lazare, Québec kept his 1800 square foot house a comfortable 23 °C with his wood stove. He points out, "it was the first time we used our stove regularly." Guy Chateuneuf in Saint-Luc-sur-Richelieu noted that his passive solar R-2000 Home gained 4 °C on sunny days, while only losing 2 °C overnight.

Wood heating back-up systems figured prominently in these cases. Wood heat can be efficient, but only tested units that meet EPA or CSA criteria for low emissions are allowed to be used in R-2000 Homes. These units can have an effective efficiency of 65 - 70%, which is close to that of conventional mid-efficiency central heating systems.

In New Brunswick, Lynn McLaughlin reported that her family's R-2000 Home endured outages of 8 to 16 hours without any alternate source of heat, and without any noticeable loss in temperature. George Queen said his home sailed through three days of power outage thanks to a direct-vent propane fireplace that kept the house comfortable, without the central forced air system running.

A Nepean real estate agent has also gained a new-found respect for R-2000 Homes because of the long power interruption. Liz Hilliard, an agent with All-Pro Realty Inc. says that she never really gave much thought to R-2000 Homes, but that has all changed. "I am now sold on the benefits of R-2000 Homes. Having seen how families like the Hoveys lived so comfortably for 5 days without power, I can now fully appreciate the quality and comfort benefits found in R-2000 Homes."

While all homes built today are well insulated and much more energy efficient than homes built in the 1970's and earlier, an R-2000 Home goes even further to reduce heating costs and energy consumption. Often, the difference between the cost of a conventional house and an R-2000 Home is offset by the lower operating costs for an R-2000 Home. This means that the combined monthly mortgage and heating costs for an R-2000 Home are often less than a conventional one.

However, the value of R-2000 goes far beyond the cost savings. R-2000 families like the Hoveys remark on the quality of construction, marvel at the quietness of their homes, delight in the comfort and enjoy the lower energy costs. "My husband has always joked that we could heat this place with a candle," Mrs. Hovey adds. "The ice storm has certainly proved that he really wasn't joking at all." ☼

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000

Letters to the Editor

Stories from the ice age

Just read the January issue and thought I would offer a couple of stories that might be of interest to your readers. I did not have the occasion to monitor R-2000 house performance, but let me give you a bit of the strange perspective on things.

Homes with well-insulated basements (on the walls, and especially those with soundproofing (insulation) in the basement ceiling) performed well, but those with no insulation under the slab did better than those with under-slab insulation. When the objective is to stay above 40°F, ground heat is incredibly useful.

For two similar basements, both with minimum wall insulation, the key factor determining how long we could keep the basement above freezing was how well we could isolate air movement from the house above. Houses with baseboard heat did better than those with ductwork that let the heat out of the basement. If power came back on for 4 hours, we could keep the basement from freezing for three days, so we publicly requested that temporary power be focused not on the living space but on the basement to protect the foundations and the water lines.

Water powered backup sump pumps were one of the heros of the week. They attach to the regular sump pump, with a higher second float. If the water goes past the first "on" point, the second float valve (not an electrical switch) uses city water pressure to drive the pump.

Those who had gas fired hot water heaters could easily keep the basement above freezing unless they had made the mistake of changing the standing gas pilot for an electronic ignition. There was a rash of re-conversions the week after the crisis. "Take this complicated modern energy efficient stuff away!"

The prize for the most ingenious improvised heating system was a gas fired domestic water tank and five lengths of (well gasketted) garden hose. The hose was snaked from a hot water outlet through the house and let drip continuously into the kitchen sink. 50°F was easy to maintain in a moderately insulated house, and 60°F was possible if the water flow was increased. The beauty was that it used a gas fired heat source that was safely vented to the outdoors and could withstand some rather heavy use.

Jan Eakes
Montréal, QC

I am amazed to hear of the reliance on pumps to keep basements dry. I am told that pumps need to be used because of bad run off design and high water tables so that many basements are below the high water level (Montréal is on an island). City storm sewers regularly backup because of overloading of the capacity by new development.

Something is drastically wrong when new structures are built to rely on continuous pumps to keep them dry. Obviously another argument against building full basements in such locations. Ed.

Re: New BC Building Code

Does the 1995 National Building Code include the energy standards in the Energy Codes for Houses and for Buildings? I understand the National Energy Code has been published, with various revisions suggested since the draft code was issued two years ago.

Please clarify, as I am sure other **Solplan Review** readers are confused!

Keith A. Veerman, P.Eng.
Trail, BC

When the energy codes were first being drafted, there was discussion about including them into the National Building Code. However, the decision was made that the National Building Code should remain a basic building structure and life safety document.

Energy regulations are considered as going beyond the basic mandate of the code, so they are kept separate documnets. The Model National Energy Code for Houses (and one for Buildings) is published as a separate document, for use by whichever jurisdictions opt to do so. All provinces initially supported the development of the energy standards. However, as they neared completion, all provinces started to back off from implementing them. BC was a strong supporter of the regulations, and was going to implement them (either as part of the building code or as a stand alone regulation) until government restructuring and downsizing eliminated the department that was supporting their development. As it stands, the proposed introduction of the 1995 National Building Code as the latest edition of the BC Building code will not include energy code requirements, although current energy requirements may be carried forward. Ed.

Re: Window Technology Upgrade (Solplan Review January 1998)

I have been involved in the manufacture high performance window and curtain wall systems for the past decade and agree with you that the use of low-E glass is becoming fairly common. When we started in the business one had to use low-E coated film if you wanted to have a window with an emissivity less than about 0.1. Today we have a choice of glass products that have an emissivity as low as 0.02 - 0.04. The location of the low-E coating is fairly important and each specific application should have windows designed specifically for that application, be it residential or commercial. Today with the excellent window analysis computer programs available it is a very fast, simple process to select the right type of glass for any specific application.

The first thing we do when we engineer a window or curtain wall system is to design the glazing unit so that the minimum indoor glass surface temperature is at about +16°C based on the ASHRAE winter design temperature for the building location. We have found, through more than 160 projects across Canada and the United States, that when the inside glass surface temperature is at +16°C or more then there is no need for perimeter heating, either above or below the window. This temperature analysis establishes the window "U" value and we then optimize the window solar heat gain coefficient and visible light transmission to meet the customer's specific requirements.

Re: Integrated Heating Systems and Bacterial Growth (Solplan Review January 1998)

Many papers have been written about Legionella bacteria problems in various parts of building mechanical systems, including domestic water heaters, but I do not think I have ever before read about the possible connection between heater type and Legionella bacteria growth. One point you may want to pass on to your readers is that scale formation (in domestic water heaters) in many water conditions increases very rapidly when water temperature is above about +50°C to +60°C. A domestic water heater that operates at +40°C - +50°C may last a long time while the same heater may not last anywhere near as long if the water temperature is increased by 10°C. As mentioned in your article, different heaters work in different ways and one should always carefully read the manufacturer's literature to make sure their application doesn't conflict with the manufacturer's recommendations.

Thank you for an interesting Journal

Don Holte, P.Eng.
Visionwall Technologies Inc.
Edmonton, AB

Utilities & the HVAC Business

Ontario utilities have been in the heating business (HVAC) through their equipment leasing program. For a long time, independent contractors have considered the utility's monopoly position as unfair competition.

With deregulation, utilities are being forced to unbundle their HVAC programs into separate unregulated companies. Union Gas will be selling its HVAC businesses to a non-regulated affiliate, Union Energy. Consumers Gas has its affiliate, Consumersfirst.

Some of these companies plan to bundle the sale of gas with other "energy-related" products and services (including HVAC). Part of their strategy for gaining market share is to purchase (or partner with) HVAC contractors and suppliers. Union Energy has already started on an aggressive program of gathering the best HVAC companies as part of its strategy to take a leadership role in major markets such as Toronto, Ottawa and Winnipeg.

Union Energy and Carrier Canada have also formed a strategic alliance that gives Union the right to market Carrier's HVAC products in Canada. Union will offer Carrier products exclusively, including private label products, to its Canadian customers. Carrier will promote Union Energy's products and services exclusively through its national dealer base. ☼

US Recall Program Replaces Plastic Vent Pipes

A product recall in Ontario has now spread across the USA. Virtually the entire furnace and boiler industry have announced a recall program that will replace, free of charge, an estimated 250,000 high temperature plastic vent pipes that can crack or separate at the joints and leak carbon monoxide (CO).

Vent pipes subject to this recall program are labelled "Plexvent ," "Plexvent II" or "Ultravent ". For furnaces, only vent pipes that go through the sidewalls of structures are subject to recall. For boilers, all systems are subject to recall. Other plastic vent pipes, such as white PVC or CPVC, are not involved in this program.

Consumers with eligible systems will receive new, venting systems free of charge. Those who have already replaced their vents may be eligible for reimbursement for some or all of the replacement costs. In Ontario, a class action lawsuit is still underway. ☼

Technical Research Committee News

Engineered Wood Joist Spans

Wood is very strong but flexible, so that floors can feel soft and bouncy even when they are structurally sound. This is a condition many builders encountered when wood-I joists were first introduced, although lumber joists are also subject to this in some situations. That is why vibration criteria for solid wood floor joists were introduced into the 1990 National Building Code span tables for Part 9 building floor joists. The vibration criteria reduced spans for lumber floor joists that did not have bridging, strapping or glued sub-floor (a gypsum ceiling on the underside gives the equivalent performance as strapping).

Research on engineered wood floor joists (wood-I and floor trusses) has been completed and the manufacturers are revising their spans to conform with the vibration criteria for their products. (However, the span tables for lumber joists are not affected). The effect of the vibration criteria for engineered wood products is that, in most instances, the spans will be reduced from the current spans for a "bare floor" (i.e., when there is no bridging, blocking, strapping or ceiling underneath) and the subfloor is not glued down. Some span reductions could be as much as 3 feet.

The allowable spans increase if you provide blocking, strapping and glue the sub-floor down. Mostly, the spans for the floor joists with blocking, strapping and a glued sub-floor are the same as the current spans. Gluing the sub-floor and providing blocking is recommended practice for engineered wood products. This will make the spans conditional upon whether or not these have been provided.

Engineered wood products are proprietary and each manufacturer calculates and publishes their own span tables based on the strength characteristics of their product. Manufacturers are now submitting their revised span tables to CCMC for approval.

Carpet Discolouration

Members have been noticing an increased number of carpet blackening cases - especially noticeable on light coloured carpets. Causes include air leakage from the exterior as well as pressure imbalances within the house. The discoloration is common enough, and creating enough problems that CHBA will be asking CMHC to support a detailed investigation of the problem, to develop solutions that will solve the problem.

Building Envelope Failures

Recent building envelope failures in BC have gained a high profile. The problems are happening despite the Building Code's clear and explicit regulations and continuing advances in the understanding of the behaviour of buildings. In BC the problem has been identified as one caused by a combination of factors that include a construction boom over the past decade, inappropriate designs and details for a mild but extremely moist climate, poor workmanship and quality control on site and zoning regulations that encourage inappropriate designs.

Research on the nature of the problem and possible means of addressing the issue has been going on for the past two years. To address shortcomings at the construction phase, a quality control protocol that can be used by professionals, builders, and inspectors is being drafted, and is to be available later this spring. CMHC is developing a "Best Practice Manual" for building construction types found on the West Coast. This document will contain suitable sample details, and is slated to be ready in the spring of 1998.

Education and training is a major part of the program. A significant start has already been made. The Architectural Institute of BC, the Canadian Home Builders Association of BC, the BC Wall and Ceiling Association, CMHC and product suppliers have cooperated in the development of a stucco application seminar that has been widely offered.

However, it appears that the problem is not unique to BC. Similar problems have been identified in buildings in other areas, including Nova Scotia, and the eastern seaboard of the USA. Now envelope failures are showing up in Alberta as well. As a result, the TRC will be asking CMHC to expand its work in this area to take into account Alberta problems.

The Alberta economy is booming, as is the construction industry. Could the problems have something to do with the pressures of increased activity and slackened supervision?

Ice Storm Fallout

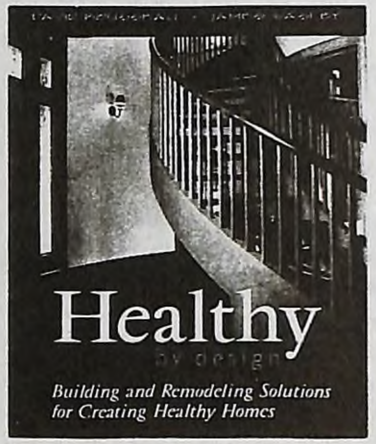
We have heard about the trauma that central Canada suffered this winter, as the worst ice storm in a century hit the area. What are the lessons to be learned from this experience? CMHC will be looking at the implications to housing from the recent ice storm.

Canadian Home Builders' Association

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

Canadian Home Builders' Association,
Suite 500, 150 Laurier Ave. West, Ottawa, Ont.
K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214
e-mail: chba@chba.ca
http://www.chba.ca

Healthy Homes by Design



Construction technology, materials and mechanical systems have changed dramatically over the past 50 years. We are living in the period of the great chemical revolution. The side effects, of which we are only now becoming aware, are environments that compromise our health. It has taken some time for us to recognize the consequences of the "sick building syndrome" in commercial buildings. The homes we live in are just as seriously compromised, but we often do not realize it.

Indoor air quality is a serious problem in many houses, yet few people are aware of the many contaminants in the air we breathe. Prevention is the best medicine when it comes to protecting yourself and your customers from harmful pollutants in the home. These pollutants often come from building materials and furnishings, or they may be the result of the physical design of the houses and the heating, ventilating and water systems where dust, mould, and bacteria can build up. Thankfully, there are solutions to these potential health hazards.

What makes a house healthy will depend on many factors, and depends as much on the location and design as on the construction details and materials used. We can read books and manuals to find out what approaches are best to reduce the impact on residents, but case studies are often more valuable at showing the scope of options.

In their new book, ***Healthy by design***, David Rousseau and James Wasley discuss the full range of issues involved in creating healthy housing.

Healthy housing principles, solutions and case studies are brought together in a practical and accessible guide to creating healthy homes. Issues covered range from design and construction considerations to the trade-offs between health, energy conservation and resource efficiency.

The centre piece of the book are nine case studies from Canada and the USA. These range from the Toronto Healthy House - a showcase demonstration that pushes the aesthetic and technical limits, to the Barhaven Community Housing project in Ottawa, an apartment building for environmentally hypersensitive individuals. Other examples include a variety of custom houses representing various locations and climatic zones of North America. Some are new houses, others are renovations.

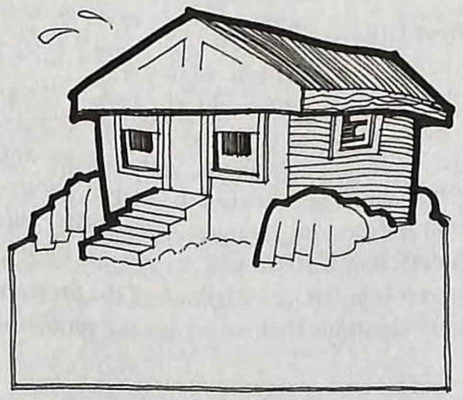
Each is illustrated with both colour and black and white photos. The examples prove that advanced healthy houses need not look unusual. Some houses are no different from anything else in their neighbourhood. Others deliberately make a bold architectural statement.

The case studies not only describe the project, but also discuss the construction and supervision challenges faced by each project. The most constant problem faced by the builders and owners was one of communication. Because of the need sometimes to use unconventional products and techniques (including strict policies about no smoking and no toxic chemicals on the site), a preconstruction meeting with all sub trades was found beneficial. When all team members know the intent of the project, the work tends to go more smoothly.

Builders and designers will appreciate two features of this book. A checklist of healthy materials and systems lists common elements found in every house, from the site and foundation through to interior finishes and water treatments and identifies options to avoid and what the preferred solution is. A list of 79 illustrated solutions to common construction details and techniques provides excellent commentary on key points to consider with the details.

R-2000 builders may recognize many elements as they are covered in the builder training and technical requirements. However, the commentary focuses on the healthy aspects of construction. It is well written, technically sound, and keeps in mind common sense construction requirements.

This book is a valuable tool for everyone concerned about creating healthy environments at home and work. ☼



Healthy by Design: Building & Remodelling Solutions for Creating Healthy Homes
David Rousseau and James Wasley
Hartley & Marks, Publishers.

Prescriptions for a Healthy House

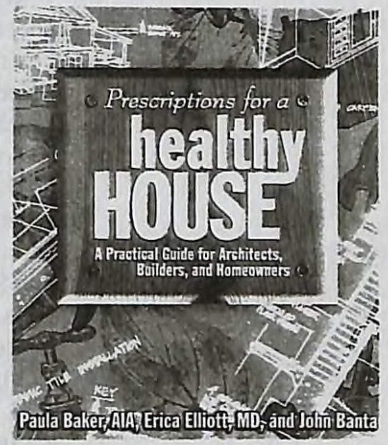
Baubiology (the biology of building) is a philosophical approach to the analysis of buildings and building systems. The baubiology movement was founded by Dr. Anton Schneider in Germany, where it has a strong following. It focuses on the relationship between the individual well-being (health), the design and materials used in the built environment and planetary ecology.

Baubiology challenges the fundamental principles of building science on which codes and practices are based. It stresses the issue of moisture control and ventilation in buildings, and also electromagnetic fields, design, materials, light, colors and a wide range of other topics. A key point it seems to stress is the need for a building to "breathe" naturally, rather than being reliant on technology.

The baubiologists tend to keep their knowledge close to themselves. Unless you take courses offered by the Institute of Baubiologie and Ecology (by correspondence or in scheduled sessions from their Institute based in Florida, after which you can become a certified baubiologist) you cannot assess their approach fully. This is unfortunate, as it makes them look like a New Age cult, although they may have a valid message.

As the healthy house issue begins to gain awareness, many new books are being written. Each offers their authors' insights, adding to the body of knowledge in the field.

Prescriptions for a Healthy House is written by an architect, doctor and consultant team, each of whom has personal experience with environmental sensitivity. The book is distinguished in two respects. The material is laid out following the 16 point Master Format of construction specifications so that targeting specific topics of interest is easy. The second is that the authors' approach the subject based on the precepts of baubiology.



Ignoring the philosophical tone to this book, there is much interesting material here, including the many references to case-studies from personal involvement illustrating a point they are making. Some refer to construction issues, others to examples of problems people encounter with pollutants in their environment: whether it is construction related, or in their environment (such as agricultural sprays, cleaning products, etc.). Unfortunately, the authors do not make it clear that their experience is focused in the US southwest, and that many of their solutions are especially appropriate to that area. Not all are readily transferred to cold climates, especially the subarctic conditions one encounters in Canada.

The most valuable contribution they make is suggesting text that can be added to specifications to deal with the key issues related to each aspect of work. Product sources (all USA) are also identified. Because of the medical background of one author,

Signage

The following sign is to be made and prominently posted on the job site. It is the responsibility of the general contractor to ensure that his labour force, all subcontractors and their labour forces, and all suppliers be made aware of these rules and follow them at all times.

Text of sign to be posted on site:

This house is being constructed as a healthy home. Only specified products and procedures may be used. If in doubt, contact the general contractor.

The use of any toxic substances such as pesticides, fungicides, or noxious cleaning products is prohibited anywhere on this site.

Smoking within or near the building and its garage or outbuildings is strictly prohibited.

No gasoline generated machines or open combustion heaters shall be used inside or near the house after the foundation is completed.

Spills or fuels, solvents, or chemicals must be avoided. If a spill occurs, report it to the general contractor immediately.

Alternatives to specified materials must be approved in writing by the owner and/or architect prior to use.

From: Prescriptions for a Healthy House: A Practical Guide for Architects, Builders and Homeowners

Prescriptions for a Healthy House: A Practical Guide for Architects, Builders and Homeowners, by Paula Baker, Erica Elliott, and John Banta. High Mountain Press, Santa Fe NM. US$29.95

there is extensive discussion about the chemical composition of the many products we use every day.

It is interesting to note that a material safety data sheet (MSDS) will not provide all the information you may want to have. Some ingredients are classified as trade secrets, and do not have to be revealed. Ingredients of "inert" fillers, which can sometimes be as much as 99% of product volume, do not have to be identified, although as they point out, occasionally they are highly toxic in their own right. In the USA, by law (the OSHA Hazard Communication Standard), physicians and health providers are allowed access to all product ingredient information for diagnostic and treatment purposes.

There are a few errors and omissions in the book. Rather than make a case against attached garages, which are a major source of pollutants, especially critical for the environmentally sensitive, the authors merely talk about being careful to seal off the area. (Even for normal healthy people, it would be a good idea if garages were detached). Another, is a case-study description about the removal of moulds from a crawl space - heroic measures were followed disinfecting the crawl space and house. However, no mention was made of a simple step to remove the source of the moisture by putting a moisture seal over the crawl space floor.

The authors also appear to be confused about the function and construction of air and vapour barriers, do not seem to have a good grasp of foundation water proofing (probably not a major problem in the southwest US), and the section on mechanical systems (including ventilation) is particularly weak.

Despite its shortcomings, this book is a valuable reference addition for all those concerned with healthy housing. However, a word of caution is required: there are technical errors, and not all suggestions made are appropriate to Canadian construction practices and climates. ☼

Healthy Home references

The Healthy House
US $ 23.95
The Healthy House Answer Book
US $ 8.95

Check your bookstore, or directly from the publisher: The Healthy House Institute, 430 N Sewell Rd, Bloomington IN 47408 Fax 812-332-5073 www.hhinst.com

If all houses were healthy, we would not need to spend time doing research for products and construction practices. We would not need to search out good books and reference sources. (Then again, a growing number of consultants would be out of business). The fact is, though, that many products are still being manufactured with little attention to their impact on health. Too many houses (new and old) are unhealthy, and too many people are suffering the consequences, often unknowingly.

To avoid unhealthy homes, we need to know the proper materials to use, how to analyze available options, and even the questions to ask when making specification decisions. Getting the right answer is often a challenge, as every question has two answers: a long one and a short one. If you (or your customers) need to get answers about healthy housing issues, you now have two new options from The Healthy House Institute, both well worth the investment.

The Healthy House (first published in 1989) has just been revised and updated. John Bower, the author, is a pioneer of the Healthy Housing movement in the USA. This is a large (650 + pages) encyclopaedic book with plenty of detailed practical information.

The Healthy House Answer Book (by John and Lynn Marie Bower) is a small book that provides the short simple answers before you need to look for the detailed answers. This small book answers the 133 most commonly asked questions about healthy houses. An excellent starting point. ☼

You asked us:

1. about heat recovery ventilator efficiency

I recently moved to a new home with a heat recovery ventilator. There is no doubt that a well-insulated home combined with a ducted and balanced HRV system is much more comfortable and energy efficient than an older home. I was surprised however at the amount of warm air my HRV pumps out of my house. This has spawned two questions to which I am trying to answer:

1) How much of the heat energy (in % terms) from the exhaust air is actually recovered and transferred to the intake air by current HRV technology?

2) Besides humidity, are there other reasons for extracting the air at ceiling level in homes to be exhausted by the HRV system (i.e., do most other common household pollutants collect at ceiling levels)? Would it be more efficient to extract the cooler air at floor level to an HRV system but recycle the humid air at ceiling levels through a closed loop circuit that incorporates some from of mechanical dehumidification?

All HRVs today are tested according to a CSA Standard for rating performance, which includes the energy consumption for fans. Results are published twice a year by the Home Ventilating Institute (HVI) in the HVI Certified Home Ventilating Products Directory.

The efficiency depends on several factors, including the total air flow and temperature difference. Most units are about 60% efficient under normal conditions. The most efficient units have ratings approaching 84%. However, it is important to recognize that at the low air flows that are the norm with ventilation systems, the overall energy cost of ventilation, while appreciable, is not large.

If you think that the HRV exhaust air is taking too much heat out of your house, you should check the system to ensure that it has been installed correctly, is balanced and is operating at a reasonable airflow for your needs. This may not be at the same level as the system capacity.

Ventilation air quantities should be fine-tuned to only provide for the needs of the occupants. A family with a full time homemaker, 4 small children and several pets in a small house will generate more pollutants and require more fresh air than a working couple with no children or pets in a large home. Often, an air flow of about 50% of rated capacity is adequate. The ventilation system should allow fine-tuning of airflows to satisfy a range of needs, but have the capacity to meet the occupancy for which the house is designed. In R-2000 homes, part of the certification protocol is an inspection of the ventilation system, and includes a check for speed control.

The primary objective of ventilation is to deal with the basic needs of the occupants. Ventilation removes the moisture, odours and carbon dioxide generated by the occupants of the house. In most houses, the worst air (most in need of being exhausted) collects at the ceiling. In the kitchen and bathrooms, heat from cooking and bathing lifts the odours and moisture to the ceiling. In the living areas, body pollutants are lifted by the 100 watts of body heat generated by each person. In most homes, even if the heating system is forced warm air and its blower is running continuously, there is little to disturb this layering because the air mixing from inexpensive residential floor grills is poor. That is why for effective ventilation, the exhaust should always be taken from the ceiling.

If you feel that the house is too dry from over ventilation (not an uncommon concern in cold weather) then you should definitely check the airflows.

2. about the importance of duct sealing

We are gearing up for a big duct tightening training program for heating contractors. It occurred to me how come most of the action concerning ducts is in the USA and not Canada? Certainly you have got lots of forced air systems where some ducts are placed outside the heated envelope, especially on the West Coast. Even for those houses where all are ducts are inside the envelope, you have much tighter houses with combustion appliances that could backdraft. Given how cost effective duct tightening appears to be, I'm surprised I don't read more about it from Canada.

D.B., Oregon

It is an interesting issue. Typical duct systems can lose 25 to 40% of the heating or cooling energy put out by the central furnace, heat pump, or air conditioner, especially when the ducts are outside the conditioned space (i.e., in the attic or crawlspace).

Leaky ducts outside the heated envelope add to the air leakage in the rest of the house. The leaks in the ductwork can represent 10 to 20% of the leakage area of the house. During a heating season, the energy losses from ducts when the fan is off can be nearly as great as when the fan is on!

Much of the activity in the USA started because of electric utility concerns about peak loading (mainly in the south eastern USA). In those areas, much of the air-conditioning ductwork is put in the attic, so any duct leakage is a major concern. Attic duct repairs could be the most important energy improvement measure one could take.

Leakage in the duct system can also be a health hazard. Leaky returns in an enclosed space such as a basement (or garage that also contains the furnace) can be a problem. The air leakage from leaky ducts can pressurize or depressurize the basement or garage, and this can draw flue gases from the furnace or soil gas into the house. Leaky supply ducts in the basement will pressurize the space, so that basement pollutants will be driven into the main living area.

Generally, in Canada, all the ducts are kept inside the heated envelope of the house, so the consequences of leaky ducts may be a more difficult balancing of the system. It is only on the West Coast (the mild climate zone) where some ducts may be installed outside the building envelope (usually in the crawl space).

As a result, the "recognition" meter has not registered too much yet. That does not mean that duct leakage is not a problem. Pressurized basements are a concern, but the degree of the problem, and indeed the source of the problem hasn't yet been seen as a big issue.

One other issue is that the strength of the staff at the National Research Council's Institute for Research in Construction has been in building science, not in mechanical issues. That itself has a bearing where study and research effort has been placed. ☼

Energy Answers

Rob Dumont

Can you save energy with a typical natural gas furnace by shutting warm air registers in rooms that are seldom used? By reducing the energy supplied to the rooms, your total space heating bill should be lowered, shouldn't it?

I would advise against the practice.

Reducing the warm air flow through a furnace in the hope of saving energy is like tightening a necktie on a person in the hope that he will lose weight. The technique is painful, and may be fatal. So also with warm air furnaces.

One of the greatest determinants of gas furnace efficiency is the amount of warm air that can pass through the furnace. If this air flow is reduced, the furnace efficiency will fall.

To take an extreme example, if the warm air flow through the furnace was completely blocked, the furnace efficiency would be essentially zero, and the house would never heat up.

Reducing the warm air flow through a furnace will *always* reduce the efficiency. The energy that you save by having some rooms cooler will more than likely be lost in the lowered furnace efficiency.

It is true that in a house with electric baseboard heating reducing the room temperature in certain rooms will save energy. In effect, you are lowering the temperature difference between inside and outside, and the efficiency of the electric heater is not reduced. A gas furnace is much different from an electric heater.

The efficiencies of gas, propane, oil or wood furnaces depend on maintaining a good warm air flow through the furnace. Don't do anything to reduce that air flow, and please, clean furnace filters periodically. We have seen some furnace filters that are almost completely blocked, particularly in houses where there are smokers.

***Rob Dumont** is a building scientist with more than 20 years in building energy use and indoor environment.*

*Rob was honoured by the Canadian Home Builders' Association at its annual meeting in Hamilton, where he received the **William M. McCance Award**, presented annually to the individual deemed to deserve special recognition for his contribution to technical research in housing.*

He has displayed a life-long commitment to living and promoting energy conservation and sustainability. He has been involved in the development some of Canada's leading technology initiatives, such as the R-2000 New Home Program, the HOT-2000 software program, and the Advanced Houses.

Another problem with reducing the warm air flow through furnaces is that the internal heat exchanger experiences greater temperature cycles, and consequent cracking.

The cheapest, and safest way to save energy with a natural gas furnace is to use an automatic setback thermostat. With this approach you do not impair the efficiency of the furnace.

I have noticed that newer gas furnaces are a bit noisier than older furnaces. The newer furnaces mostly have exhaust fans for the combustion gases that contribute to the noise, but the noise also may be coming from the greater air flow. What makes the new furnaces noisier?

Newer gas furnaces have a higher warm air flow for the same BTU/hr output capacity than the older furnaces. For instance, many newer mid-efficiency furnaces typically have a rated warm air temperature rise of about 70°F (39°C); older furnaces tended to have a rated temperature rise of about 100°F (55°C). Other things being equal, the newer furnaces thus need about 40% more air flow than the older models.

One of the installation issues that arise from this higher air flow through newer furnaces is that many sheet metal installers have not adjusted for this higher air flow. As an example, an older 100,000 BTU/hr output furnace needs about 925 cubic feet per minute (cfm) of air flow based on a 100°F temperature rise. A new furnace with the same output capacity rated at a 70°F temperature rise will require about 1320 cfm or 41% more air flow. If the same ductwork is used, the air velocity will be higher, and more air noise will be present.

Most gas furnaces have traditionally been greatly oversized. A study by Bert Phillips of UNIES for the Canadian Electrical Association amply proved this fact.

One way to control noise when a furnace is being replaced is to replace the furnace with a smaller BTU output model. A qualified tradesman should be able to calculate the actual peak heat requirement of your house based on your past heating bills.

How do you calculate the amount of furnace oversizing in an existing house?

Here's a quick way to calculate roughly how oversized your furnace is. Use the January natural gas consumption for average January weather conditions. The example is for a house with a January natural gas bill of 30,000 cubic feet and a furnace with a rated input of 100,000 BTU/hour and a bonnet capacity (output) of 75,000 BTU/hour.

Assume a natural gas consumption for January of 30,000 cubic feet, which amounts to about 30 million BTU (850 cubic metres or 300 therms or 31.6 gigajoules). Subtract about 2.5 million BTU for the natural gas water heater consumption for one month. (This assumes that there is only a natural gas furnace and a natural gas water heater in the house.) Take the rated input capacity of the furnace (100,000 BTU/hr) and divide the furnace consumption by the 100,000 BTU/hr figure. For this set of readings, the answer is 27.5 million/100,000 = 275 hours. This means that the furnace in this example was on for only 275 hours out of the 31days (744 hours) in January. This amounts to only 37% of the hours in January.

For more accurate furnace sizing, the furnace should typically be on for about 60% of the time in a typical January here on the prairies. This 60% figure comes from the fact that the average January outdoor temperature is warmer than the outside temperature for design purposes. The 60% figure also leaves about a 15% safety margin.

The useful output from the existing furnace was 20.6 million BTU for the month (275 hours times 75,000 BTU/hr). The new furnace should be on for 60% of January hours, or 446 hours. Thus, the average furnace output capacity should be 20.6 million BTU/446 hours or 46,188 BTU/hr. If the new furnace is 80% efficient, the new furnace should have an input capacity of 46,188/0.8 = 57,735 BTU/hr. Thus an 80% efficient 60,000 BTU/hr input furnace would be sufficient to replace the old 75% efficient 100,000 BTU/hr furnace.

As the new furnace will run more hours in the heating season, choosing a furnace with a high efficiency furnace fan motor to reduce electricity consumption is important. The best furnaces use either brushless DC motors or high efficiency AC motors. ☼

The Fireplace in the house as a system
A practical guide to fireplace perfection (even in tightly sealed new houses)

People love fireplaces; they always figure prominently on a new home purchaser's wish list even though fireplaces are often a source of disappointment and annoyance. They usually put out less heat than expected, spill exhaust gases into the room when operating, and spill cold air and foul odours when they are not.

Open appliances, such as fireplaces without doors or gas appliances with draft hoods, have little resistance to spillage, and are very vulnerable to combustion spillage. The design of traditional masonry fireplaces actually is not conducive to successful venting. That is why wood burning fireplaces are not considered suitable for today's well sealed energy efficient homes. However, this past winter's storms in Central Canada will no doubt rekindle interest in solid fuel combustion appliances.

In general, energy efficient houses can accommodate combustion appliances with modest combustion air requirements (supplied from inside the envelope) without a make-up air system, provided large exhaust fans are not installed. Except in rare cases, even tightly sealed houses have enough natural leakage to supply combustion air to controlled combustion woodburning appliances.

Why do chimney vented fireplaces spill and backdraft and what is needed to make them function successfully? That seems like such a simple question, but it is not. Although venting failure has been a problem for many years, much of the formal research and analysis needed to reveal the dynamics of chimney venting in houses has been done only in the past two decades.

Fireplace design may be more an art than a science. Manufactured hearth products (wood stoves, gas fireplaces, masonry stoves) receive more intense scrutiny and are also tested to meet performance and emissions criteria. However, all these appliances are at the mercy of their relationship to the rest of the house.

There is no doubt that because energy efficient houses can be so air tight, the pressure inside will be affected by other exhaust systems. The only way to be sure that a venting system can function properly in such houses is to test them, using a simplified house pressure test.

For a successful installation, it is important to understand the key principles that define proper fireplace operation. Venting of combustion products is crucial. The installation of glass doors is the most effective and least expensive way to increase the spillage resistance of open fireplaces.

When a venting system is in operation or even at standby, several influences are simultaneously at work: chimney height, stack temperature, fireplace design, house tightness, wind effects, and outdoor temperature. The bigger the temperature difference between inside and outside the more

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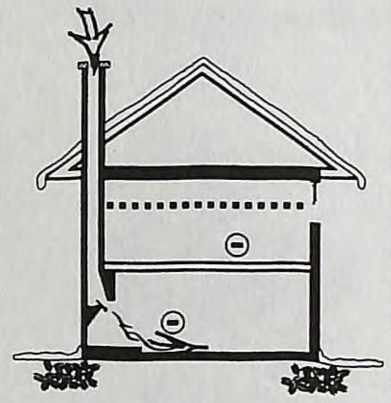
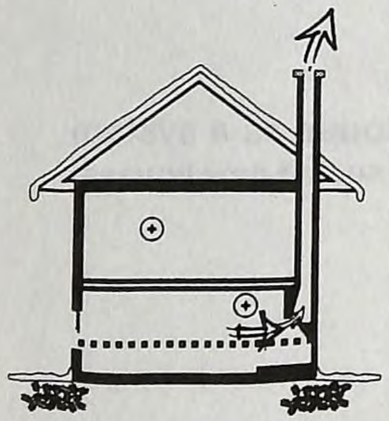


An open window is like a very large leak, and since the NPP follows the leaks, it will move to its level. In some cases an open upstairs window can change the house pressure enough to backdraft a fireplace located low in the house.



When a fireplace is cold backdrafting the flow direction can be reversed by opening a nearby window, thus neutralizing the normally negative pressure low in the house.

draft is produced. Taller chimneys usually produce a stronger draft at a given temperature difference. Unfortunately, there are cases in which the house performs better as a chimney than the chimney itself - that is when backdrafting can take place. Wind flowing over the top of a chimney can also produce a driving pressure that can either increase or decrease the draft depending on wind direction or turbulence.

It is often thought that cold air leaks from a fireplace simply because cold air is heavy and falls down the chimney. However, this is a misinterpretation of the physics. While it is true that cold air is heavier than warm air, it does not fall down the chimney. Rather, it is drawn down the chimney toward the zone of lower pressure. Cold air flows down the chimney because it always flows to zones of lower pressure, not because it is heavy.

Venting problems should be avoided at the design stage. Chimneys must be placed inside the building envelope. The chimney should penetrate the building envelope at or near its highest point. Exterior chases must be built inside the building envelope, all the way to the top.

A few years ago, building scientists and hearth specialists were convinced that bringing combustion air from outdoors to the appliance was the answer to venting failure problems. Now we know better. The real problem with the passive makeup air strategy is that it does not reliably supply combustion air.

Although it is enshrined in some building codes and its adherents are often vocally forceful, there is no scientific evidence to suggest that outdoor air supply, either directly to the combustion chamber or indirectly supplied to the living space, is a reliable and effective remedial measure for combustion spillage from the appliance for which the supply is intended.

Passive air supplies do not supply combustion air, but only allow air in response to the pressure in the house. Directly-ducted combustion air supplies can reverse their flow direction when wind creates a negative pressure area at the outdoor weather hood. This means the "supply air duct" can become a horizontal chimney.

High mass masonry units, with masonry chimneys, can create a thermal momentum because of the ability of bricks to store heat. The more energy momentum created in a system, the more resistant it will be to spillage during the fire tail-out phase especially if the building is depressurized. This is why masonry chimneys have an advantage over prefabricated metal chimneys.

No matter what the design, there is a human factor in woodburning. The most problematic user influence is allowing the fire to smolder, a condition that promotes dangerous closed-door spillage.

John Gulland, author of The Fireplace in the house as a system, has written a book that clearly addresses the issue of how to make sure a wood burning fireplace will work properly. He convincingly argues that when the building science physics are given proper consideration, a wood burning fireplace can be used in a well-insulated energy efficient home without compromising health, indoor air quality or safety. ☼

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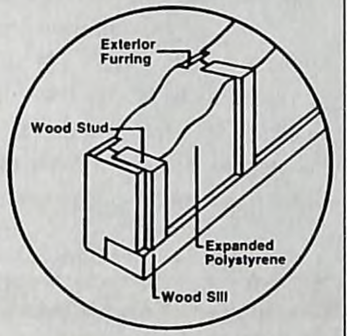

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